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PRE-PRINTED CORRUGATED BOARD FABRICATION AND CUT-OFF CONTROL METHOD AND APPARATUS

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The present invention relates to pre-printed corrugated board fabrication and automatic cut-off control method and apparatus, enabling extremely high quality printing to be applied to one of the liners of the corrugated board prior to the fabrication of the board and automatically aligning the cut-off position with the terminations of each printed pattern when the corrugated board is cut to length for use in boxes, display stands, games, and the like. By means of the method and apparatus of the present invention a continuous pre-printed paper web, or so-called liner, having a high quality of printed material thereon, is fed into a corrugated board combiner so as to form an outside face of the finished corrugated board. While the corrugated board is being cut to length, the printed designs appearing on the outside face of the corrugated board are maintained accurately centered in the cut-off pieces and cumulative error in the location of successive cuts is eliminated.

More particularly, the present invention relates to the method of and apparatus for fabricating pre-printed corrugated board and automatically controlling the instantaneous rate of feed of the corrugated board from the delivery end of the drying and cooling section of a double-facer type corrugated combiner to maintain the cut-off correctly aligned with a pre-printed design on the corrugated board and advantageously to eliminate cumulative error.

Corrugated board has been widely used for many years because of its high strength, light weight and many other desirable characteristics. However, there is one important problem in the field of corrugated board which has been troubling the field for many years without solution. This problem is the relatively low quality of printing which has heretofore been forced upon the industry by the characteristics of corrugated board. Double faced corrugated board is formed by a pair of spaced sheets called liners, with a corrugating medium between them. The crests of the corrugating medium support the liners along spaced narrow areas with the liners spanned across from crest to crest. Any attempt to print fine on the liners causes the spanned portions of the liners to sag away from the printing dies and leaves an uneven impression which is commercially unsatisfactory.

Prior to the present invention printing on corrugated board has been done by rubber printing dies which are abruptly struck against the liner during the printing process. In this way the impression is made before the liner has any substantial opportunity to sag. However, the resulting equality of printing and the designs which can be obtained are far short of those life-like qualities obtainable with lithographic, gravure and other high quality types of printing processes.

Among the many advantages of the present invention are those resulting from the fact that it enables the utilization of these high quality types of printing processes to be applied on a continuous web which is later used to form the outside liner of the finished corrugated board. In the combining process described as embodying the present invention, this previously printed web is unwound from the unwind stand of the double-facer section of a corrugated combiner. The pre-printed liner is combined

with a corrugating medium and another liner and forms a continuous corrugated board which is fed through the glue drying and cooling section of the combiner. It is then cut into lengths for use in boxes, display stands, games, and the like.

During the printing process, a series of spaced marks are applied to the liner for registering the location of the cuts with respect to the repetitions of the pre-printed design. In the method and apparatus described as illustrative of the present invention these register marks are evenly spaced and a plurality of these marks are provided for each repetition of the design. As used herein the term "repetitive design" is intended to include a plurality of separate designs printed one after another, sometimes called a "blotch print," as well as a continuous pattern with a repeat unit in it.

These register marks are suitably scanned and the combiner is automatically controlled to assure that the positions of the cuts fall between successive repetitions of the pre-printed design. All of the pieces of the corrugated board are advantageously cut to substantially the same length and cumulative error between the positions of successive cuts and the repetitive pre-printed material are eliminated.

Previous attempts have been made to utilize pre-printed liners in corrugated board, but these attempts have not been commercially successful. The pre-printed material was undesirably scuffed in the corrugated combiner machine and the cut-off location did not remain in aligned synchronism with the pre-printed material. As a result, cumulative error crept into the operation. The cuts fell into the middle of the pre-printed designs, rendering the final product a total waste from a commercial point of view.

In prior attempts to control the location of the cuts with respect to the pre-printed material on the corrugated board, the control action has been applied to the cut-off knives. This has been unsuccessful commercially for several reasons. Corrugated board is relatively rigid and stiff. Thus, the cutting knives must be moving at the same speed as the corrugated board being fed past them during the instant when the cut is made. If the knives are too slow, the corrugated board jams against them crushing and crumpling the leading edge of the cut pieces, weakening the corrugated board and spoiling it for commercial use. If the knives move too fast with respect to the corrugated board, they pull and tear at the leading edge of the cut pieces, leaving a jagged cut which is commercially unsatisfactory.

In order to obtain the desired synchronism between the motion of the knives and the corrugated board, the knives are driven at varying rates of speed, during different portions of each cutting cycle. At the instant of cut the knives move most swiftly. Then the knives are slowed down relative to the velocity of the corrugated board so as to delay their motion and to allow a suitable period of time to elapse before the next cut is made. The amount of delay in knife motion is increased in order to increase the length of the pieces being cut. Corrugated combiners in use today include eccentric drives or yoke drives which are adjustable and which produce the desired speed of the knives with respect to the speed of the corrugated board at the instant of cutting. These knife drives provide for adjustment of the knife speed and the delay in the knife motion so as to cut off the corrugated board in the desired lengths.

In prior attempts to control the location of the cuts with respect to the pre-printed material on the corrugated board those in the field have attempted to control the operation of knives so as to position the cuts at the desired places on the corrugated board feeding out of the